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OBSERVATIONS ON THE BIRTH AND POST-BIRTH BEHAVIOR OF *SYNTROPIS MACRURA* KRAEPELIN (SCORPIONIDA: VAEJOVIDAE)

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ABSTRACT

The birth and post-birth behavior of the scorpion *Syntropis macrura* Kraepelin (Scorpionida: Vaejovidae) is described and discussed. Birth of an entire litter of 33 young took approximately 37 hours. The young were precocious, with few of them ascending onto the mother's back. Mortality was high, with only two second instar young surviving. Post-birth associations of the first instar nymphs with the mother are described.

INTRODUCTION

On 23 March 1971, a female *Syntropis macrura* Kraepelin (Vaejovidae: Syntropinae) was collected by Vincent F. Lee at Puerto Balandra, Isla del Carmen, Baja California Sur, Mexico. On 3 January 1972, more than nine months later, this scorpion began giving birth to 33 young during a time span of approximately 37 hours. The birth appeared to be abnormal in several respects which will be discussed later, but is worthy of note for two reasons. First, it is the first observed for this genus, and second, it differed from the birth processes of other members of the family Vaejovidae.

The systematics of this primarily New World family of scorpions has been given considerable attention in recent years. However, behavioral studies have lagged behind. Stahnke (1966) mentioned that first instar *Hadrurus arizonensis* Ewing do not molt until at least 16 days after emergence. Williams (1969) discussed the birth behavior of 14 species of North American scorpions, including *Anuroctonus phaiodactylus* (Wood), *Hadrurus arizonensis* Ewing, *Uroctonus mordax* Thorell and five species of *Vaejovis*, all of the family Vaejovidae. While concluding that the birth process and post-birth association of the young was quite similar in the species of *Vaejovis*, there was insufficient comparative data for the other genera. Haradon (1972) described the birth behavior of *Uroctonus mordax*, observing that, unlike first instars of *Vaejovis* spp., first instars of *Uroctonus* spp. are randomly positioned on the mother's back. He concluded that significant variation of birth patterns exist in the family Vaejovidae and that this variation is of taxonomic significance and tends to support the maintenance of *Uroctonus* as a separate genus.

Based on the observations of the above-mentioned authors, several conclusions may be drawn about the birth behavior of New World vaejovid scorpions.

1. A stilting posture is assumed prior to delivery and is maintained until delivery is complete. This consists of raising the body high above the substrate with the pedipalps usually held out away from the body.

2. A "birth basket" is formed by the first two pairs of walking legs being held together close to the substrate. This basket furnishes a place for the young to extricate themselves from the birth membrane and increases the chances for ascent to the mother's back.

3. The length of time spent in parturition varies from one to 7½ hours, depending on the number and size of the young and on the occurrence of complications.

4. There is a gestation period of from eight to twelve months.

5. There is no preferred time of parturition.

6. Litter size ranges approximately between ten and seventy.

7. Nearly all of the young ascend to the mother's back.

8. The first stadium lasts for one week to at least 16 days.

9. Orientation on the mother's back may be either non-random, that is, facing anteriorly with the prosoma down and the metasoma curled over the back, as in *Vaejovis* spp., or random as in *Uroctonus*. The pattern of orientation of the first instars of *Anuroctonus* sp. and *Hadrurus* spp. is still open to question.

10. The mother remains sedentary until after the young have left her back.

11. The young are not precocious, but remain on the mother's back until after the first molt. Those which do not ascend to the mother's back die in a short time.

It will be seen that my observations of *Syntropis macrura* show significant differences from these conclusions.

METHODS

The mother was housed in a plastic box (178 mm × 83 mm × 45 mm) until all the young had emerged and were on the mother's back. At this time, she was transferred to a larger plastic box (381 mm × 278 mm × 172 mm) which was supplied with a dirt-gravel substrate and several large rocks with some vertical facings to simulate natural surroundings. The mother was kept well fed on crickets from the time of her arrival. The surviving second instar young were fed immature crickets which were readily accepted and eaten. Water was supplied in a dish for the mother and by an occasional sprinkling for the young.

THE BIRTH PROCESS

Delivery Posture—The mother prepared for delivery by assuming the stilting posture common to other vaejovids. All vaejovid births observed up until this time have revealed that the mother uses the first two pair of walking legs to form what has been called a "birth basket." The behavior of *Syntropis macrura* differs in that only the first pair of walking legs are used. Also, instead of being held close to the substrate, as in other vaejovids, the legs are held close to the body in a horizontal position just under the genital operculum (Fig. 1). The young, as they emerge, are caught by the legs at the junction of the carapace and mesosoma. During the birth process, the mother was quite active, giving up the stilting posture between births and walking around the box.

The young did not emerge in any set position. Of the 23 observed births, 14 young emerged head-first. Of these, eight emerged in a right-side-up position. Of the remaining six, three emerged upside-down and three sideways. Nine emerged tail-first. Of these, six were right-side-up, two upside-down, and the last sideways. There appeared to be a tendency toward a right-side-up orientation whether emergence was head-first or tail-first.

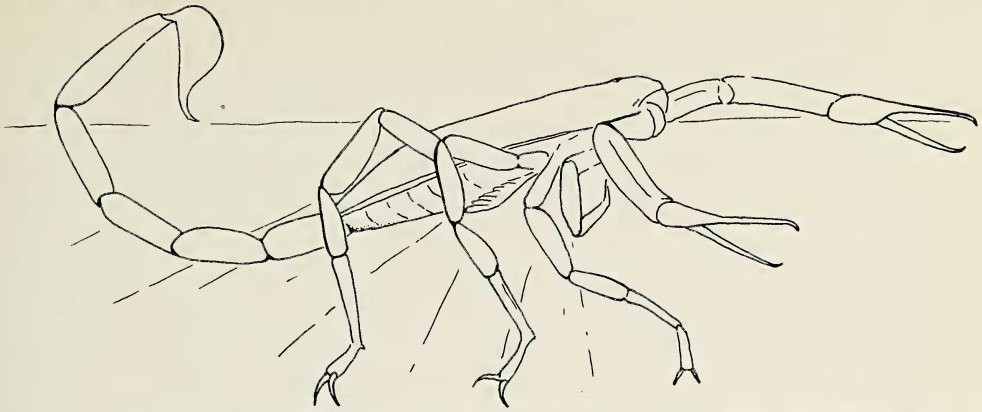

Fig. 1.–Illustration of the mother's posture during delivery. Note that only the first pair of walking legs are used to catch the young.

Delivery Time–Delivery of the entire litter of 33 young took approximately 37 hours, from sometime early in the morning of 3 January to sometime early in the evening of 4 January. This is an unusually long time compared to other vaejovids, even though the number of young cannot be considered unusually large. It can be seen from Fig. 2 that the hours between 1847 and 0032 appeared to be the preferred time of parturition, when one-third of the litter emerged on an average of 35 minutes apart. The average time between emergences over the entire 37 hours was 72 minutes (based on intervals between the 23 observed births). The actual times required for emergence ranged between 15 seconds and one minute. One scorpion was born dead in a shrivelled condition.

POST-BIRTH BEHAVIOR

Most of the young freed themselves completely from the birth membrane within 45 minutes, some in as little as 30 minutes. Others had some difficulty, one taking nearly two hours. The manner of shedding the membrane was the same in all cases. First, the pedipalps and carapace were freed, then each pair of walking legs, then the mesosoma and, finally, the metasoma. The stickiness of the birth membrane enabled the young scorpion to remain on the mother's legs until its own legs were free. At this point, the young scorpion began to walk about or ascend to the mother's back. The membrane sometimes became caught between metasoma V and the telson, in which case the scorpion simply carried it with him.

Surprisingly, and unlike other vaejovids, few of the young ascended onto the mother's back. The first to attempt the ascent was No. 17 (see Fig. 2). It took one hour and 38 minutes from the time of emergence to gain the mother's back. Ultimately, only five of the 33 young made the ascent.

Also unlike other vaejovids, the first instars were quite precocious. Two instances will serve to demonstrate this precocity. First, one which had ascended to the mother's back in the normal manner (that is, up the chelicerae, pedipalps or first two pair of walking legs), wandered down to metasoma IV of the mother (after having been on her back for at least two hours). The mother responded by flicking him off of her tail, turning around, picking him up with her pedipalps and transferring him to her chelicerae where she held him by the mesosoma. Two hours later, she released her hold and the young scorpion climbed over to the coxa of the right pedipalp. It then climbed back to the chelicerae, then under them, and made its way to the right side of the mother between the pedipalp and first walking leg. From there, it got onto the femur of the mother's pedipalp and

Fig. 2.—Duration of birth process, showing times of birth. Numbers refer to individual young; lines indicate births not observed. All births considered complete by 2000 hours based on the previous night's performance.

finally, 20 minutes after having been released from the mother's chelicerae, ascended the mother's back for a second time. In the second instance, one of those not immediately ascending to the mother's back walked to the opposite end of the container, up the side, back to the other end along the side of the box, and back to the ground. It then climbed onto the mother's tail at metasoma II and then onto her back.

The behavior of the mother toward the young also seemed unusual. Those which emerged onto the ground were picked at whenever they moved. In a seemingly hostile fashion, she would quickly grab at them with one or both pedipalps. This usually consisted of squeezing them and then quickly releasing them and drawing the pedipalps back. On more than one occasion, she picked one up with the fingers of one pedipalp and held it for some time. At other times, she would transfer it to her chelicerae. One was held this way for nearly 5½ hours but was alive and apparently healthy after being released. Those young that ascended onto her back were subjected to repeated attempts at removal during the first day. The mother would scratch at her back with the third and fourth pairs of legs much as a dog after fleas.

As of 5 January, five young were on the mother's back, seven were in the container with the mother (alive but not on her back), seven had been placed alive in a separate container for comparative purposes, seven had been removed and preserved in alcohol and the remaining seven appeared dead.

On the morning of 5 January, after all of the young had emerged, the five on the mother's back were all facing posteriorly. On the next morning, three of the young were facing anteriorly and two remained facing posteriorly. On the next day, four were facing anteriorly and only one was facing posteriorly. Finally, on 10 January, all five were facing anteriorly as in most other vaejovids. However, on 13 January, one was again facing posteriorly. This situation was maintained while the young remained on the mother's back.

On 20 January, all of those in the separate container were still alive, but only three of the seven in the container with the mother were alive. All of the bodies were accounted for, so it is certain that the mother did not eat them, and it is doubtful that she would kill them without eating them. The mother showed no interest in an introduced cricket.

The first molt occurred on 21 January, 18 days after the birth process began. By 22 January, four of the five young on the mother's back had molted, two of them already having left the mother. All molting was completed by 24 January. By 30 January, only two second instars were left alive, both under rocks. All of the other young had died. Of those that were not on the mother's back, only one completely shed its skin. The others either showed no signs of molting or else molted only partially. This would seem to indicate that, for reasons unknown, the first instars must ascend onto the mother's back in order to undergo a successful molt.

On 6 June, one of the young died while still in the second instar. The last specimen molted on 14 July and died a week later. Thus, the length of the second stadium, based on this single specimen, would be about 5½ months. The causes of death are unknown.

The first instars, like other scorpions, were completely white except for black eye spots; with blunt pretarsi and a blunt aculeus, and with no evidence of setae or trichobothria (Fig. 4). The second instars had the trichobothria visible, and the aculeus and pretarsi were darker and well-formed (Fig. 5). The body was lightly pigmented, with

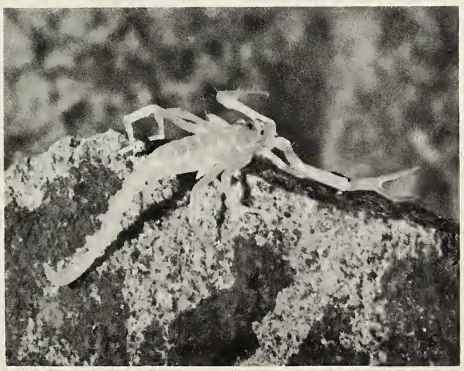

Fig. 3.–Female *Syntropis macrura* with newly molted second instar young on her back. Note the cast skin of one young attached partially to the mother's carapace.

Fig. 4.–First instar of *Syntropis macrura*. Note blunt aculeus and pretarsi and lack of pigmentation.

Fig. 5.–Second instar of *Syntropis macrura*. Note the formed, darkened aculeus and the presence of trichobothria.

a whitish band along the posterior margin of each mesosomal segment. Also, the second instars were more slender than the first instars, with the pedipalp fingers and other pedipalp segments being noticeably longer in relation to the rest of the body. The third instar was similar to the second but larger and more darkly pigmented.

DISCUSSION AND CONCLUSIONS

These observations revealed that there are similarities to the birth behavior of other vaejovids, yet showed some significant differences. The similarities were that *Syntropis* assumed a stilting posture, the gestation period fell within the normal range, an average number of young were produced, the first stadium lasted for 18-20 days (about the same as *Hadrurus*, but several days longer than that of *Vaejovis*), and that the first instar orientation had a tendency toward being non-random. However, as mentioned in the introduction, this birth appeared abnormal in several respects. First, the unnaturally long parturition time probably was due to the young being improperly oriented within the mother prior to birth. This would also explain why the young were oriented in so many different positions upon emergence, although this aspect apparently has not been observed in other vaejovids, and comparison is not possible.

It was very unusual for so few of the young to ascend to the mother's back. In other vaejovids, this appears to be a necessary part of the development of the young. That so few ascended in this instance may be again due to complications within the mother and the multi-oriented emergence of the young. Those young which emerged tail-first or upside-down had almost no chance of immediate ascent, but fell to the ground after breaking out of the birth membrane. Those that emerged head-first and right-side-up were able to grasp the mother's supporting legs after freeing themselves from the membrane. This is still not the full explanation, since eight young emerged in the ideal position and only five made the ascent. However, the possibility that first instar *Syntropis* are naturally precocious and could have survived under natural conditions still remains. Finally, the mother's restlessness and unusual behavior toward the young could also have been an indication of internal complications or also of outside influences.

There are two aspects of the behavior which I feel were normal even though they departed from the usual vaejovid behavior. First, the hours between 1800 and 0100 appeared to be a preferred time of parturition, and secondly, only the first pair of walking legs was used to catch the young rather than a "birth basket" being formed. These appear to be of such an instinctive nature that they would be unaltered by other influences and are a significant departure from the usual vaejovid behavior.

These observations would seem to reinforce Haradon's (1972) conclusion that significant variation of birth patterns exist in the family Vaejovidae. However, whether or not this variation is of taxonomic significance is open to question. Much more work needs to be done in the area of birth behavior in order to get a clear overall picture. In particular, much more data is needed on the genera *Anuroctonus*, *Hadrurus* and *Syntropis*. It seems possible that the behavior of *Anuroctonus* would differ from other genera because of the obligate burrowing habits of the genus. However, very little is known of any of these groups, and questions remain open until someone else is fortunate enough to obtain gravid females for comparative purposes.

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